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H1K KRLC K4D K5A1 K5A5 K5M2

(56) Documents Cited
EP 0620537 A **EP 0469970 A**

(58) Field of Search
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(54) Contactless data carrier

(57) A contactless data carrier suitable for use as a smart card, comprises a laminated structure consisting of core films 10,11 having a circular opening 12 for receiving a package 1 for containing an integrated circuit. The package is circular in plan and comprises equal halves 32, 33 so it is symmetrical about a plane passing through its centre. The halves are bevelled along their edges and allow the package to be received in the opening as a press-fit and located symmetrically with respect to the films 10,11. The package has conductive leads 4.1 which extend into a region between the core films for contacting an antenna. The antenna may be disposed on a further film located between the core film or take the form of a flat coil of wire located between the films 10,11 or be integrated with one of the films 10, 11. Covering films (not shown) are provided to at least partially enclose and to protect the whole package.

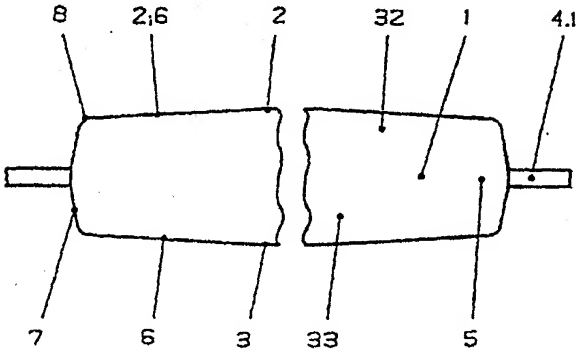

Figure 1

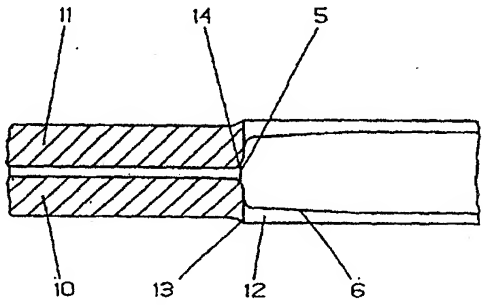

Figure 3

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At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal

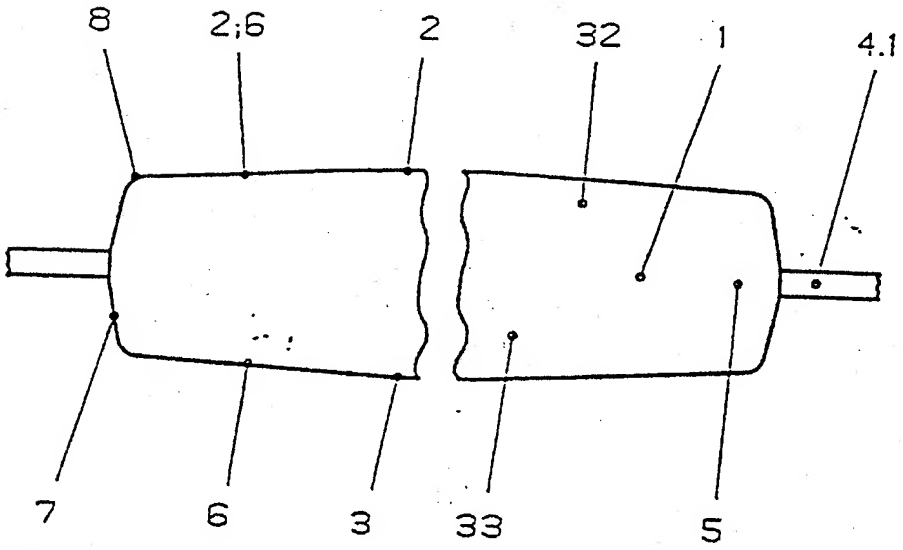

Figure 1

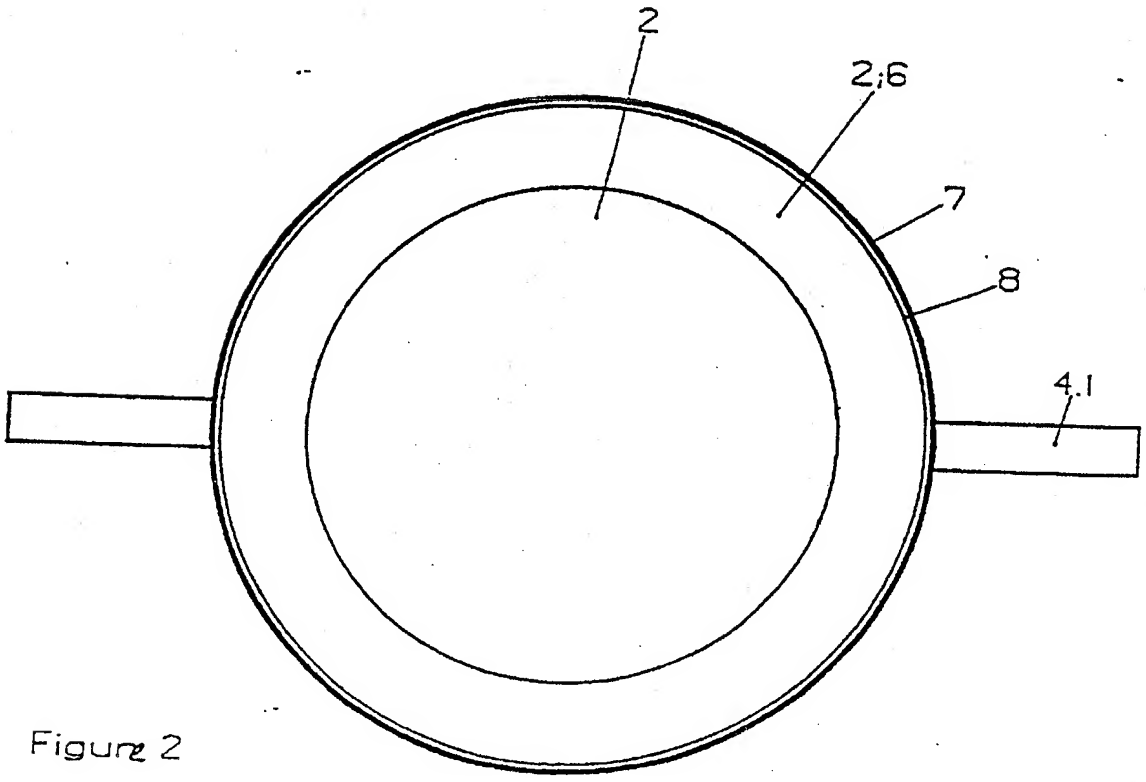

Figure 2

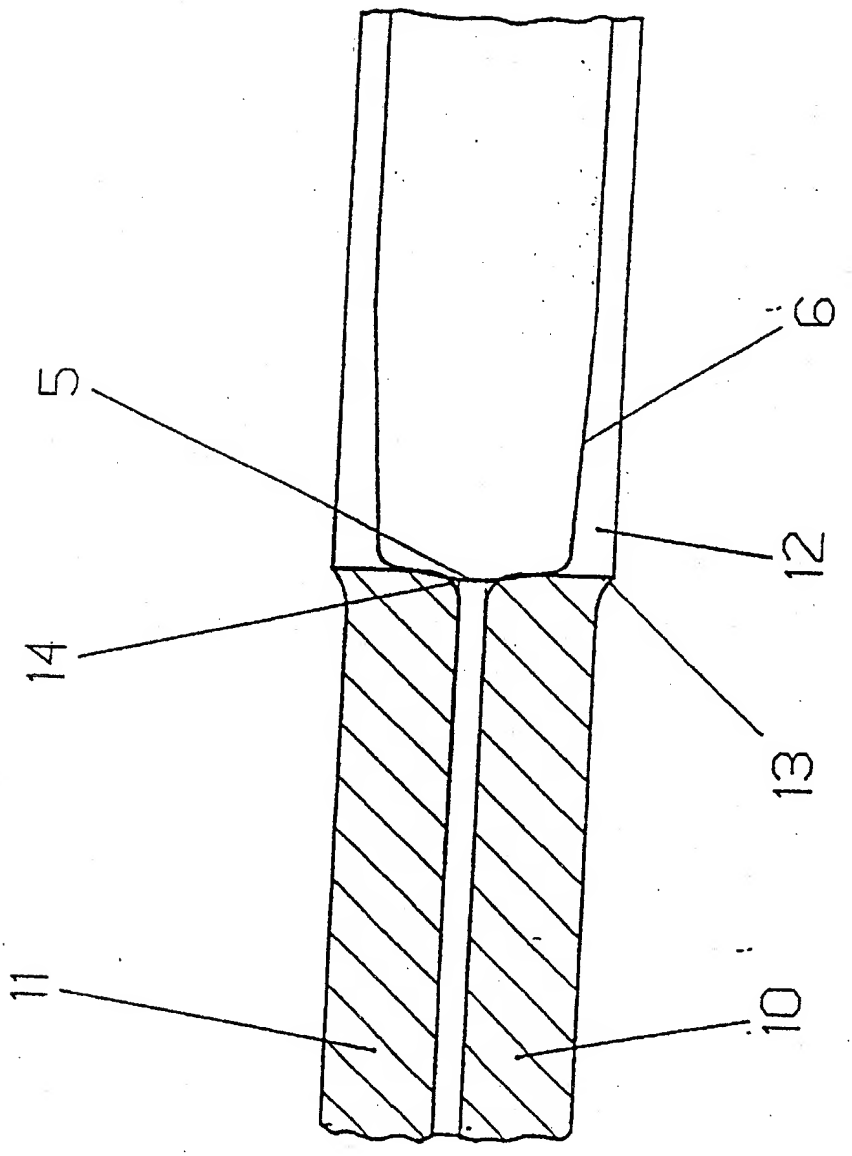

Figure 3

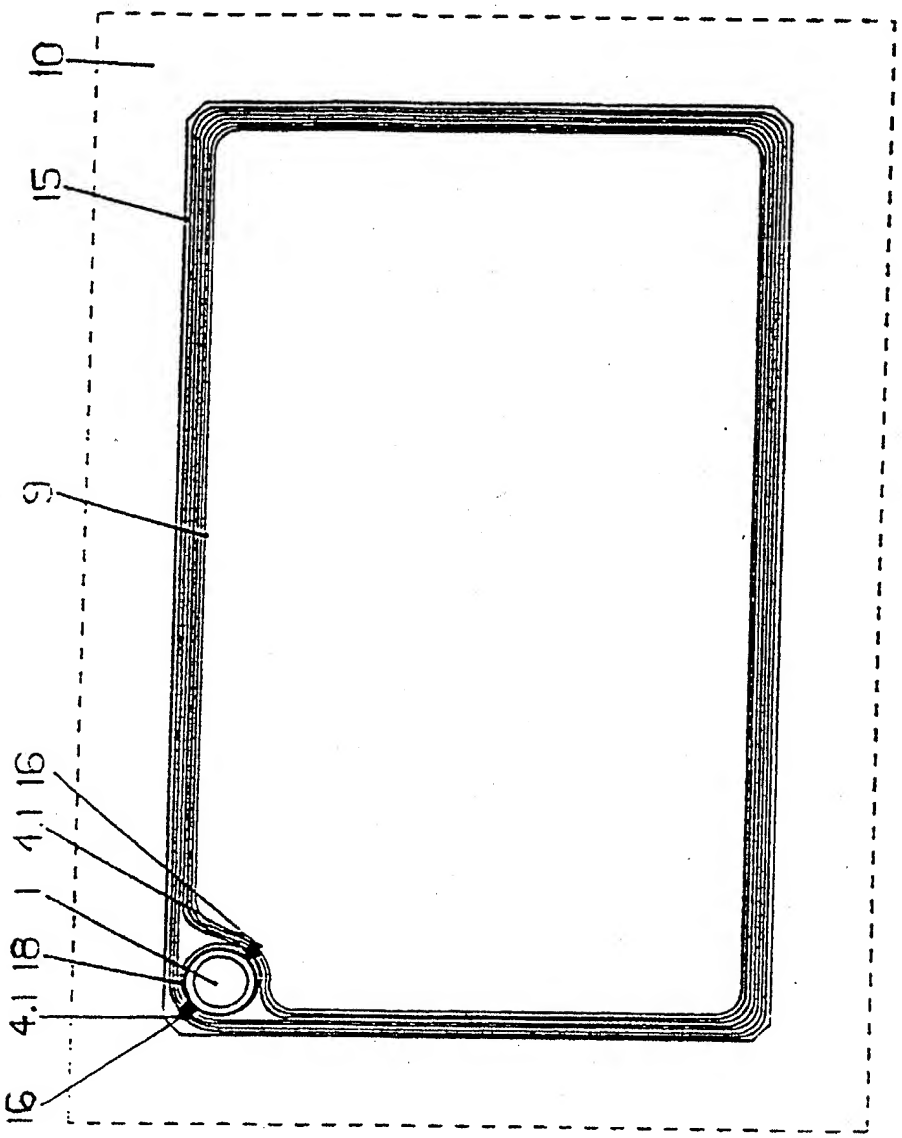

Figure 4

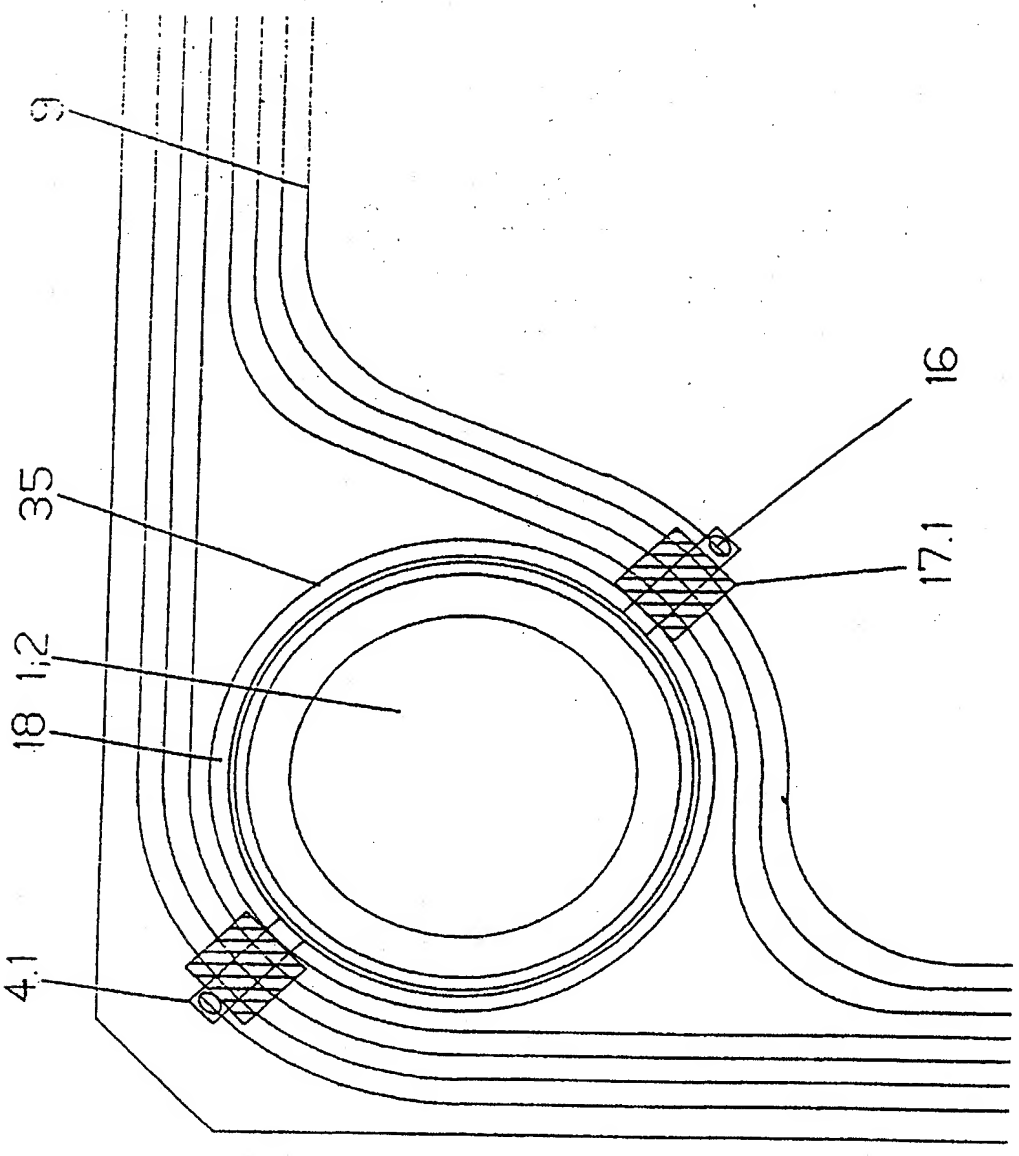

Figure 5

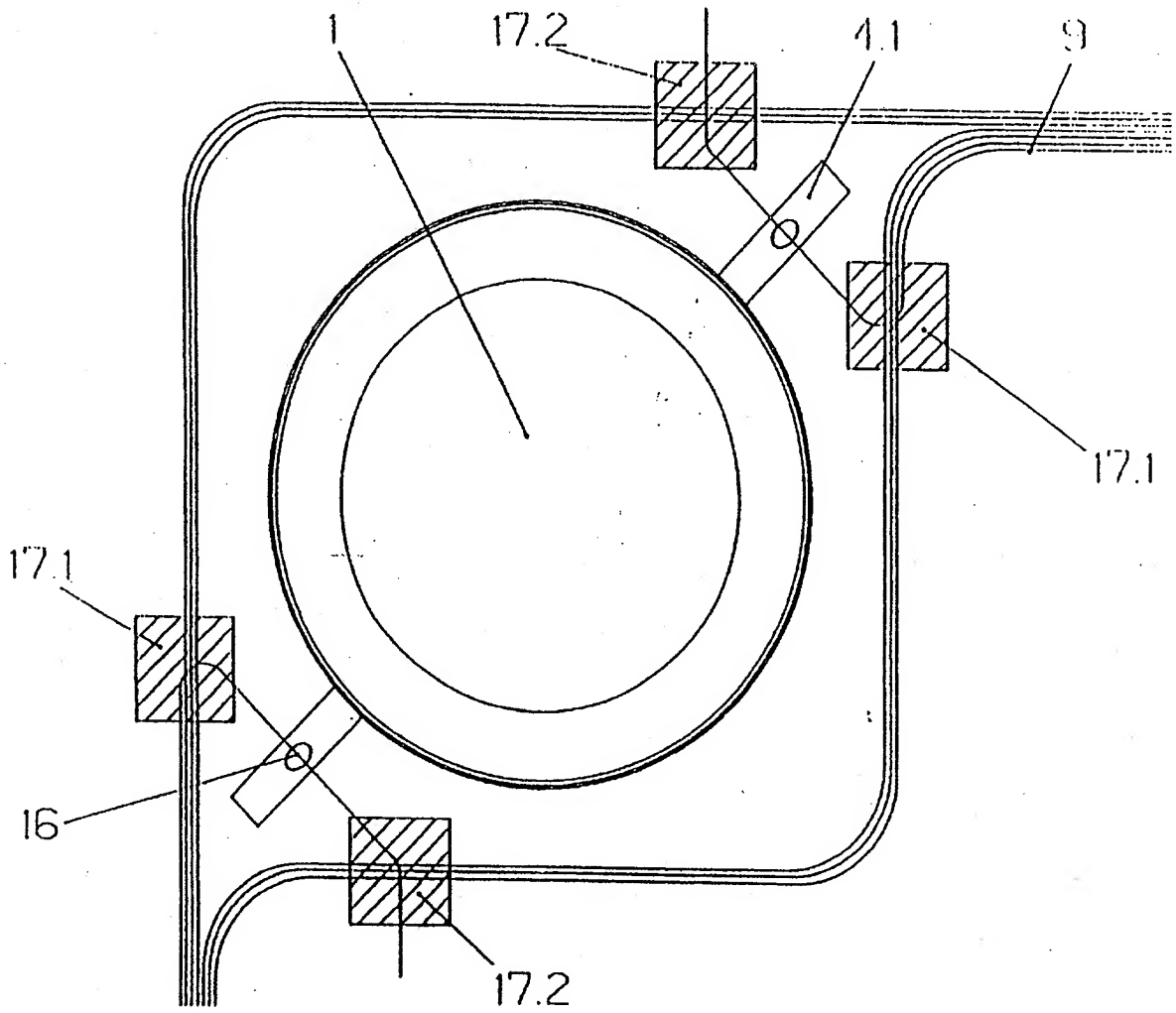

Figure 6

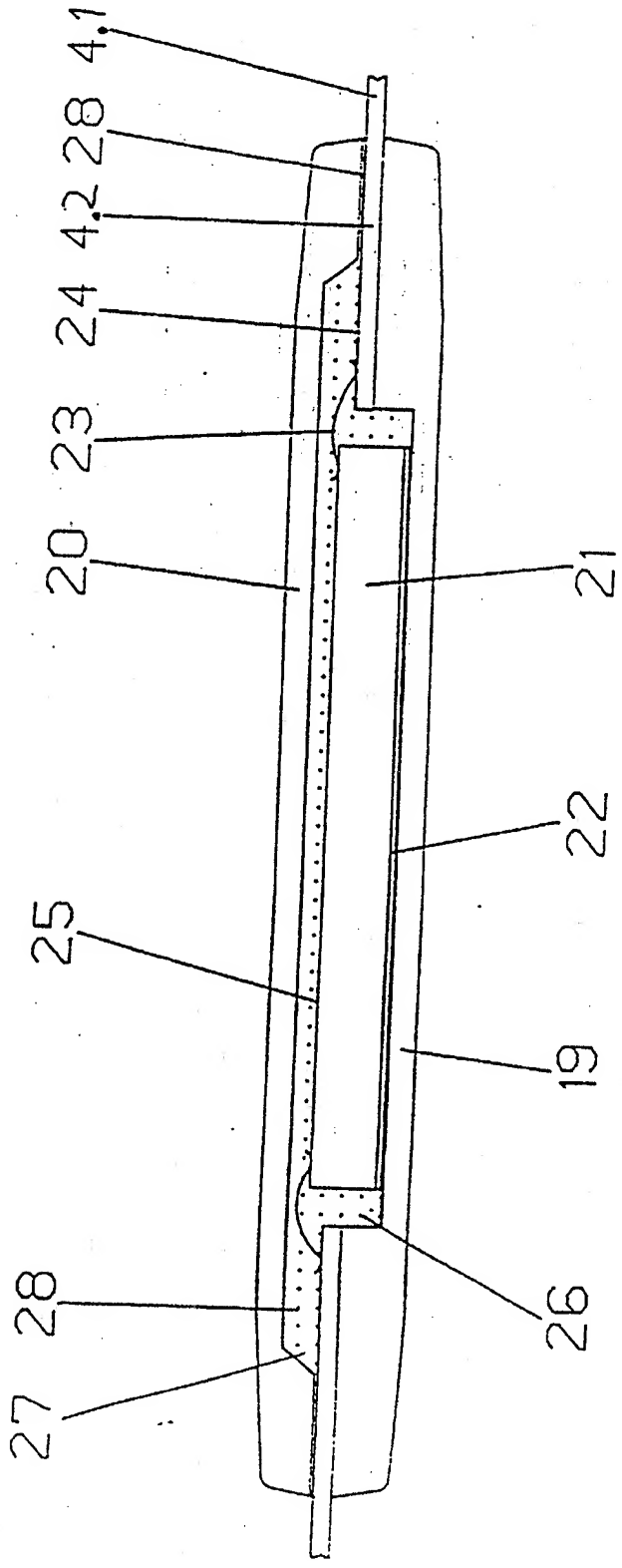

Figure 7

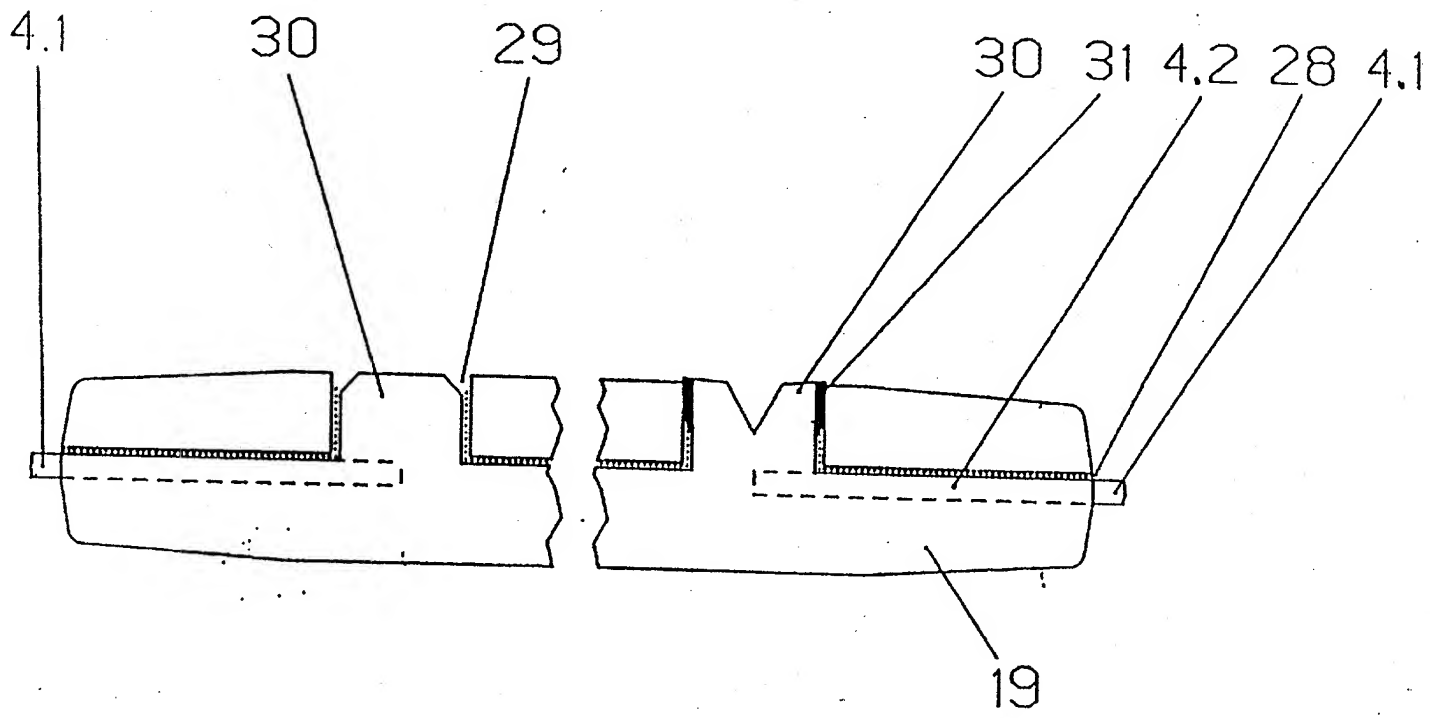

Figure 8

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Contactless Data Carrier and Process for the Manufacture Thereof

The invention concerns a contactless data carrier and a process to manufacture a contactless data carrier with laminated layer structure, consisting of an integrated circuit hereinafter referred to as a chip, disposed in a package, of core films provided with openings for the package, of covering films and an antenna.

The invention is preferably usable for contactless smart cards. However, it is also suitable for data carriers in which a package-disposed chip is connected to an antenna. Such arrangements can be used for example to protect goods against theft or as payment means with electronic protection in the form of coin-like constructions.

In the prior art, it is known to realise the data and energy transfer between contactless data carriers and the write and read stations by means of inductive coupling, microwave, or capacitive coupling. Transmitting and receiving means are antennas or metallic areas connected to the chip. To fulfil the existing dimensional standards and the mechanical stability requirements of the data carriers, the mechanical forces that occur during use must not damage the semiconductor chip, the electrical leads or the transmitting and receiving means, hereinafter called antenna.

Arrangements are known whereby the chips are affixed to a flexible conductive film, which also carries or constitutes the antenna, by means of bonding. Further it is known to mount the chips by means of direct bonding method. With these methods, the chip and the contact leads between chip and circuit card are protected mechanically by a hardenable casting or covering substance. Guard rings, fabric plates and similar materials

or arrangements are used for the mechanical protection of the chip and to simplify assembly.

The disadvantage of these arrangements and methods is that the data carriers and/or the antenna are laminated layer-asymmetrically in a plastic card, which leads to increased tensile stress on the conductors in the event of bending. Similarly it is disadvantageous that the chip lies not precisely centric in the laminate. In the event of bending and of torsional strain upon the plastic card, mechanical stress spikes occur, owing to material and constructional non-homogeneities, which can lead to the destruction of certain materials and thus to failure of the entire plastic card. A further disadvantage is that a data carrier structured asymmetrically in layer and material tends to sag.

In the sate of the art it has been attempted to partially circumnavigate these disadvantages through use of very flat miniature packages.

The object of this invention is to specify an arrangement and a process for the manufacture of contactless data carriers, which enable favourably priced manufacture, whereby mechanical tensions are largely avoided, which enable an undisturbed laminate surface of high design quality in the region of the chip, and which are distinguished through high flexural resistance.

In accordance with the present invention there is provided a contactless data carrier with a laminated layer structure, having an integrated circuit disposed in a package, core films provided with openings for the package, covering films and an antenna, wherein:

an antenna is disposed between said core films,

the package consists of two equal sized package halves, which outside are symmetrical in relation to a plane of division and have a bevelled edge and a radius,

the package is disposed layer-symmetrically in the core films as a press fit, and

the package has at least two leads in the plane of division which are connected to said antenna.

Further advantageous embodiments of the design according to the invention are specified in claims 2 to 11.

According to another aspect the present invention provides a process of manufacturing contactless data carriers having a laminated layer structure, an integrated circuit disposed in a package comprising two halves, core films provided with openings for the package, covering films and an antenna, said process including the steps of positioning said antenna on one of the core films, pressing one package half into the opening of the core film and conductively connecting the antenna to leads of the package.

Preferably the core films are disposed on said package halves in such a way that punching buff caused by core film punching points away from the package.

The data carries pursuant to the invention are distinguished by a number of advantages:

1. Owing to the pressing of the package into the core films, the package is securely affixed before lamination. It can remain on the film for various operations, it enables

secure connection with the antenna contacts through press contact or soldered or bonded contact points.

2. Owing to the small gap between core film and package, there is a stable core film bond, which prevents air traps during lamination and subsequent bend tears.

3. Owing to the rounded package edges, the laminate films flow more easily during lamination. Furthermore, the roundings reduce mechanical tensions in the laminate.

4. Owing to the bevelling of the package, the laminate is strengthened across the packaged edges, which also contributes to the stability of the laminate, especially under bending loads, and reduces the mechanical tensions across the package edges.

5. The layer-centric exit of the leads facilitates a fully symmetrical laminate structure, which advantageously affects the flexural strength of the card and the card quality. The card can also be manufactured fully flat.

Further important advantages are the very favourably priced package manufacture, the possibility to facilitate a very high level of design of smart card, high reliability owning to the optimum arrangements of the package in the opening and the card position, and the favourable manufacture of the lamination packet.

In pursuance to the process to manufacture the data carriers according to this invention, the antenna is positioned on a core film, a package half if pressed into the opening of the core film and the antenna connected conductivity to the package leads.

Thereby it is practical to dispose the core films on the package halves in such a way that the punching burr resulting from the punching of the core film points away from the package.

This facilitates self-centering during assembly of the package and an optimum fit of the package contours and the hole contour is achieved, which guarantees a neat embedding of the package in the laminate without significantly disturbing the covering films carrying the designs.

Various embodiments of the present invention will now be described, by way of examples, with reference to the accompanying drawings wherein:

Figure 1 shows a side elevation of a package incorporated in a data carrier constructed in accordance with the invention;

Figure 2 is the associated top plan view of the package of Figure 1;

Figure 3 is a partial cross-sectional view of a data carrier in accordance with the present invention showing a section of package pressed into core films;

Figure 4 is a plan view of the data carrier showing one arrangement of the package and antenna;

Figure 5 shows one arrangement for connected the package to the antenna;

Figure 6 illustrates an alternative arrangement to that shown in Figure 5;

Figure 7 shows a cross sectional view of one package incorporated in the present invention;

Figure 8 is a partial cross-sectional view of a different package incorporated in the present invention.

The package 1 represented in Figures 1 and 2 is almost layer-symmetrical in structure.

In the described example, it has the following dimensions:

the thickness of package 1 is less than or equal to 570μm and the thickness of the outer package leads 4.1 is 40 to 80μm,

the thickness of package 1 is designed to be about 10 to 50μm greater than the sum of the thicknesses of core films 10,11 and where necessary of antenna films 15 in laminated condition,

the package top halves 32 and bottom halves 33 have conical bevelling in edge region 6, whereby bevelling is disposed on a width of 0.5mm to 1mm at an angel of 5° to 10° between package top side 2 and bottom side 3 and the respective edge surfaces,

the package side areas 7 outside of the layer plane of package leads 4.1, 4.2 are bevelled and extend conically pointed in the direction of package top side 2 and bottom side 3 at an angle of 85° to 70° to package top side 2 and bottom side 3,

the package edges 8 are provided with a radius greater than or equal to 50μm.

Figure 3 shows package 1 pressed into core films 10, 11.

During the assembly of the data carrier, package 1 is pressed into core films 10, 11 similar to a double-sided, very flat alignment pin. In the example described, package 1 has a round cross-section in which external leads 4.1 project out of package 1 at a central location parallel to the layers. For usual applications two leads are sufficient. In the event of a plurality of leads, these are distributed advantageously with equal separation on the package edge. Package side areas 7 have a pointed conical package edge bevelling, which enables a simple, self-centering assembly of package 1 in core films 10, 11. The top and bottom circular package areas 2,3 are bevelled conically in edge region 6. Owing to the dimensionally adapted designs of core film openings 12 and of

package 1, an embedded disposal of package 1 in core films 10,11 is possible. The package area in the centre of package thickness 5 is greater than or equal to the hole diameter of openings 12 in the core films 10, 11, while the package area of package top side 2 and bottom side 3 is less than the hole diameter of core film openings 12. Package 1 is received through core films 10,11 to the thickness of each package half 32,33. The thickness of core films 10,11 and where necessary the antenna film 15 corresponds to, after laminating the sum of the package thickness at the package edge. Assembly is effected by pressing package halves 32,33 into core films 10,11 and subsequent lamination of core films 10, 11 and the covering films. Thereby antenna circuits 9 in the represented example are on one of core films 10,11. It is also possible to lay the antenna on a separate antenna film 15 or as flat wire coiling between core films 10,11. Corresponding embodiments are shown in Figures 4 to 6.

An advantageous embodiment results therefrom that the size of opening 35, for the insertion of package halves 32,33 through antenna film 15, is some 0.4 to 1mm larger in width than the package area in package layer centre 5, so that between the edge of antenna film opening 35 and package 1 an antenna film-free edge region 18 results. Thus during laminating a stable bond of core films 10,11 among one another is achieved directly around package 1.

Figures 4 to 6 show arrangements of package 1 in interaction with antenna 15,34.

Figures 4 and 5 show an embodiment in which film antenna 15 lies on a bottom core film 10 and in which opening 35 is disposed in which a way through antenna supporting film 15 that package 1 lies in the middle of conductor arrangement 9 of

antenna 15. Package 1 can therefore be provided with relatively short external leads 4.1 and disposed in a relatively flexurally neutral zone of the card. Thereby package opening 35 is disposed proximate to a corner of the data carrier.

Package leads 4.1 or contact points 16 of antenna 15 are disposed usefully in the direction of the card diagonals. Package 1 and the leads 4 are thus optimally positioned under flexural loading of the card. Figure 6 shows an embodiment in which a wire antenna 34 is used.

Figures 5 and 6 show practical examples of connecting package leads 4.1 to antenna 15, 34. For this purpose, antenna supporting film 15 can be covered with a temperature and pressure resistant, electrically insulating material 17.1 in the region in which external leads 4 of package 1 cross antenna circuits 9. This allows antenna 15 to be produced in a metal plane.

Package 1 can consist of plastic, ceramics and similar materials. Leads 4 are made of metal, preferably copper, iron or iron nickel and the like. They can also be realised in anodised form (gold, silver etc.). Especially suitable are packages 1 of hard elastic material. The base films for film antennas 15 are preferably produced from polyester, polyimide, circuit board material and similar. PVC, polycarbonate and ABS plastics are preferably used for core films 10,11.

To improve the design quality of the data carriers, it is advantageous to print package top side 2 and bottom side 3 of package 1 in the colour of core films 10,11. This prevents differently coloured package areas 2,3 from shining through the covering films, which can particularly disturb in the case of dark packages 1.

Figure 7 shows an embodiment where package 1 consists of two package shells 19,20 of electrically isolated plastic glued to each other. On bottom package shell 19 a supporting strip is disposed in such a way that in the glued state it is the bonding plane.

The module film required in the state of the art is no longer needed. During the chip assembly process package bottom shells 19 are part of an endless substrate strip and are therefore easily and simply transportable. Furthermore, the automatic bonder lines known in the state of the art can be used for processing.

Because the very flat, thin substrate strip is at the same level as the bonding plane of package shell 19, package shell 19 can easily be separate from lead 4.2 during handling processes.

For localisation, leads 4.1, 4.2 have, at least in the region of bottom package shell 19, a dovetailed cross-section in order to hold better internal lead 4.2 in the plastic. Moreover, internal lead 4.2 has interlocking holes to improve dovetailing.

A further advantageous arrangement is represented in Figure 8. In this embodiment alignment pins 30 are disposed in bottom package shell 19 and alignment holes 29 in top package shell 20. This enables vertical and horizontal displacements of housing shells 19,20 during adhesive or resin hardening to be avoided.

Thereby it is advantageous that, through plastic deformation of the tips of alignment pins 31, top package shell 20 is pressed onto bottom package shell 19. This causes top and bottom shell 19,20 to remain in a defined position during the period of resin hardening, whereas in known methods resin 28 presses shells 19,20 apart owing to

wetting forces. In the state of the art this is compensated for by use of weights, which, however, requires very expensive production processes.

In the case of the arrangement according to the invention, the use of weights can also be avoided in that package shells 19,20 can be secured in position during resin hardening by depositing fast bonding glue on the tip of alignment pin 30 and immediate bond soldering.

Further, it is possible to achieve, by using a casting resin 28 with a filler grain diameter that is somewhat larger than the gap alignment pin 30 to alignment hole 29 and by jamming the pin to the alignment hole wall by the filler body, an exact vertical localisation of package shells 19,20.

It is furthermore practical to reduce the load upon the contact pins and to stabilise the position of micro lead 23 by realising a wire support boss between contact area 24 of internal lead 4.2 and semiconductor chip 21.

DRAWING REFERENCE LIST

1. Chip package
2. Package top side
3. Package bottom side
4.1 External lead
4.2 Internal lead
5. Package layer centre
6. Conically bevelled edge region of a package side
7. Package side area

8. Edge Radius
9. Antenna conductor
10. Bottom core film
11. Top core film
12. Core film opening
13. Core film punching burr
14. Rounding of core film opening
15. Film antenna
16. Contact point
17.1 Insulating enamel for crossing insulation
17.2 Insulating enamel to locate lead end
19. Package bottom shell
20. Package top shell
21. Chip (Integrated Circuit)
22. Chip bonder
23. Micro lead
24. Internal contact area
25. Chip surface
26. Cavity in package bottom shell
27. Cavity in package top shell
28. Casting resin
29. Alignment hole

30. Alignment pin

31. Plastic deformed alignment pin tip

32. Top package half

33. Bottom package half

34. Wire antenna

35. Opening through antenna film

Claims

1. A contactless data carrier with a laminated layer structure, having an integrated circuit disposed in a package, core films provided with openings for the package, covering films and an antenna, wherein:

the antenna is disposed between said core films,

the package consists of two equal sized package halves, which outside are symmetrical in relation to a plane of division and have a bevelled edge and a radius,

the package is disposed layer-symmetrically in the core films as a press fit, and

the package has at least two leads in the plane of division which are connected to said antenna.

2. A data carrier according to claim 1, wherein each half of the package has an external surface forming the top or bottom of the package and each such surface has a blunt conical bevelling at an edge region.

3. A data carrier according to claim 1 or 2, wherein the sum of the core film thicknesses after lamination is somewhat less than the maximum package thickness.

4. A data carrier according to any one of claims 1 to 3, wherein said antenna is disposed on an antenna film arranged between the core films.

5. A data carrier according to claim 4, wherein the sum of the core film thickness and the antenna film thickness after lamination is somewhat less than the maximum package thickness.

6. A data carrier according to any one of claims 1 to 3, wherein one of the core films also serve as the antenna.

7. A data carrier according to any one of claims 4,5 or 6 wherein the opening in the antenna film is larger than the dimensions of the package in the plane of division.

8. A data carrier according to any one of claims 1 to 7, wherein said package is disposed with its plane of division aligned with the central plane of the antenna arrangement.

9. A data carrier according to any one of claims 1 to 8, wherein the data carrier is rectangular and the package is disposed proximate to a corner of the data carrier.

10 A data carrier according to any one of claims 1 to 9 wherein the package halves are glued to each other and a substrate strip is disposed in a bottom one of the package halves in such a way so that in a bonded state it is in the bonding plane of both package halves.

11. A data carrier according to claim 10, wherein on one of the two package halves alignment pins are disposed and on the other package half corresponding alignment holes are disposed.

12. A process of manufacturing contactless data carriers having a laminated layer structure, an integrated circuit disposed in a package comprising two halves, core films provided with openings for the package, covering films and an antenna, said process including the steps of positioning said antenna on one of the core films, pressing one package half into the opening of the core film and conductively connecting the antenna to leads of the package.

13. A process according to claim 12, wherein the core films are disposed on said package halves in such a way that punching buff caused by core film punching points away from the package.

14. A data carrier substantially as described with reference to, and as illustrated in any one or more of the Figures of the accompanying drawings.

15. A process of manufacturing contactless data carries substantially described with reference to and as illustrated in any one or more of the Figures of the accompanying drawings.

Patent Office

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Application No: GB 9606613.9 **Examiner:** J L Freeman
Claims searched: 1 to 15 **Date of search:** 11 June 1996

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.O): H1K (KRLC)

Int Cl (Ed.6): G09K (19/077)

Other: On-line: WPI, JAPIO

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
A	EP 0620537 A	(A Gustafson) Figure 2	1 & 12
A	EP 0469970 A	(Gemplus Card International SA) Figures 4 & 6	1 & 12

X	Document indicating lack of novelty or inventive step	A	Document indicating technological background and/or state of the art.
Y	Document indicating lack of inventive step if combined with one or more other documents of same category.	P	Document published on or after the declared priority date but before the filing date of this invention.
&	Member of the same patent family	E	Patent document published on or after, but with priority date earlier than, the filing date of this application.